

- 34 -

What is claimed is:

- 1 1. A method for restoring cellular phenotype in a cell affected by disease, damage, or age,  
2 the method comprising:  
3 activating an intracellular pathway that induces expression of a phenotype-  
4 specific gene,  
5 thereby to restore cellular phenotype.
- 1 2. The method of Claim 1, wherein said pathway is a pathway that is activated by specific  
2 binding of a morphogen to its transmembrane receptor.
- 1 3. The method of Claim 1, wherein said activating step comprises inducing intracellular  
2 formation of a Smad complex capable of inducing expression of a phenotype-specific  
3 gene.
- 1 4. The method of Claim 3, wherein said Smad complex comprises Smad1 and Smad4.
- 1 5. The method of Claim 3, wherein said inducing step comprises phosphorylation of a Smad  
2 molecule.
- 1 6. The method of Claim 1, wherein said activating step comprises exposing a cell having  
2 morphogen type-I and morphogen type-II receptors to a small molecule capable of being  
3 an agonist of a morphogen type-I or morphogen type-II receptor.
- 1 7. The method of Claim 3, further comprising the step of inducing translocation of said  
2 Smad complex in to a cell nucleus.
- 1 8. The method of Claim 1, wherein the cell is a hepatocyte.
- 1 9. The method of Claim 1, wherein the cell is a renal cell.
- 1 10. The method of Claim 1, wherein said activating step comprises inducing the expression  
2 of a Smad protein.
- 1 11. The method of Claim 1, further comprising the step of transfecting the cell with a DNA  
2 encoding a Smad protein.
- 1 12. The method of Claim 11, wherein said transfecting step is performed by using an  
2 adenovirus-based vector.

- 35 -

1 13. The method of Claim 11, wherein said transfecting step is performed by using a plasmid  
2 including said DNA.

1 14. A method restoring cellular phenotype in a cell affected by disease, damage, or age, the  
2 method comprising:

3 inhibiting an intracellular pathway that induces expression of a gene that is an  
4 inhibitor of normal phenotype,

5 thereby to restore cellular phenotype.

1 15. The method of Claim 14, wherein said gene encodes TGF- $\beta$ .

2 16. The method of Claim 14, wherein said inhibiting step comprises inducing expression of  
Smad6.

3 17. The method of Claim 14, wherein said inhibiting step comprises inducing expression of  
Smad7.

4 18. The method of Claim 1, wherein said activating step comprises administering a  
morphogen to a patient.

5 19. The method of Claim 18, wherein said morphogen is selected from the group consisting  
of OP-1, OP-2, OP-3, BMP-2, BMP-3, BMP-3b, BMP-4, BMP-5, BMP-6, BMP-9,  
BMP-10, BMP-11, BMP-12, BMP-13, BMP-15, DPP, Vgl, Vgr-1, GDF-1, GDF-2, GDF-  
3, GDF-5, GDF-6, GDF-7, GDF-8, GDF-9, GDF-10, GDF-11, GDF-12, 60A, NODAL,  
UNIVEN, SCREW, ADMP, and NEURAL.